National Aeronautics and Space Administration

Pre-earthquake Signatures in Thermal Infrared Data

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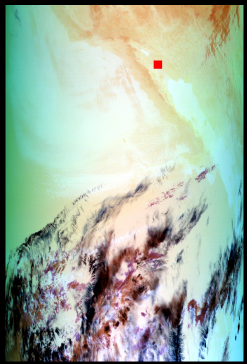
Introduction

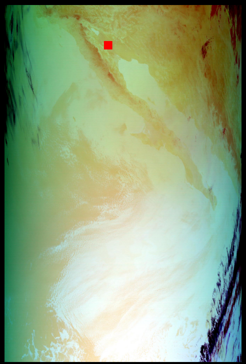
Preceding major earthquakes, changes in the Earth's Thermal Infrared (TIR) emission have been observed and, consequently, are now being monitored more closely. We are testing the hypothesis that there is a unique pre-earthquake signal in MODIS TIR satellite data by comparing data collected just before a major earthquake to data collected during periods of little seismic activity, thereby allowing this EQP (Earthquake prediction) signal, if it exists, to be isolated. Using ENVI to eliminate noise in the pre-earthquake data would increase this EQP/N ratio and determine whether this specific signature exists.

In our study, we are focusing on the 7.2 April 4th, 2010 Baja earthquake. The same method will then be applied to other earthquake locations.

Methods

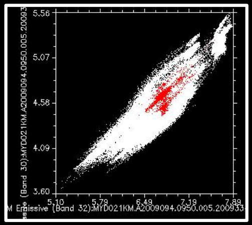


Baja 2009 MODIS TIR

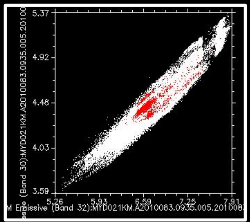


Baja 2010 MODIS TIR

Collect MODIS TIR images containing the earthquake epicenter from within a month before the earthquake and then from the previous year for comparison. In both images, identify a precise region of interest (ROI) located around the epicenter (in red).

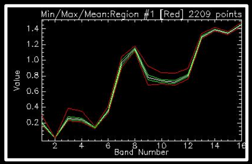


Band 32-Band 30

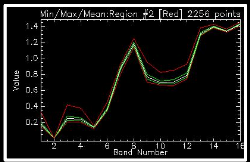


Band 32-Band 30

From image space (above), run 2D scatter plots of different emission bands for both images, importing the ROI (red). Compare this spectral space data for all band combinations.



ROI Band STATS



ROI Band STATS

Also, within the ROIs, graph Band statistics and compare them to further narrow down any source of disparities in the TIR.

Conclusion

Repeatedly traveling between image and spectral space and systematically graphing each band against the others should isolate and clarify an EQP signal in the pre-earthquake data against the control, if one exists at all. Also, further application of this method to other sets of data and locations can either clarify this EQP or further prove its nonexistence. Both serve as one step closer to discovering whether seismic activities can be predicted accurately and consistently. An accurate EQP signal would give notice weeks before an event. Since seismic events are responsible for 28% of losses and 53% of fatalities due to natural disasters and in light of 2010's Haiti and Chile earthquake devastations, this subject would have a significant global impact.

References:

NatCatSERVICE (2010). Great natural catastrophes 1950–2009. Retrieved July, 13, 2010 from: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/long-term_statistics_since_1950/default.aspx

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